

## HOW I DO IT

# Hepatic Resection of Hepatocellular Carcinomas Based on Tumor Hemodynamics

MASATO SAKON, MD,<sup>1\*</sup> HIROAKI NAGANO, MD,<sup>1</sup> JUNZO SHIMIZU, MD,<sup>1</sup>  
MOTOI KONDO, MD,<sup>1</sup> SHOJI NAKAMORI, MD,<sup>1</sup> KEIZO DONO, MD,<sup>1</sup> KOJI UMESHITA, MD,<sup>1</sup>  
HIRONOBU NAKAMURA, MD,<sup>2</sup> TAKAMICHI MURAKAMI, MD,<sup>2</sup> AND MORITO MONDEN, MD<sup>1</sup>

<sup>1</sup>The Second Department of Surgery, Osaka University Medical School, Osaka, Japan

<sup>2</sup>Department of Radiology, Osaka University Medical School, Osaka, Japan

## INTRODUCTION

Hepatocellular carcinoma (HCC) is mostly hypervascular and is frequently associated with intrahepatic metastasis [1]. Surgeons believe that the wider the surgical margin from the tumor, the more curative surgery would be. On the other hand, HCC commonly develops in patients with limited hepatic function due to associated liver cirrhosis or chronic hepatitis [2]. Therefore, the extent of hepatectomy is a controversial issue. Although some groups recommend extended hepatectomy [3–6], others advocate limited resection [7,8] based on the postoperative clinical outcome. This controversy is the result of a lack of appropriate imaging modalities that allow accurate prediction of the area containing the undetectable micrometastases adjacent to the tumor. Computed tomography hepatic angiography (CTHA) was developed to evaluate the arterial blood flow of hepatic tumors [9,10]. Ueda et al. [11] reported that CTHA not only demonstrates lesion hemodynamics, but simultaneously shows the tumor blood drainage area in the late phase of the procedure. Using CTHA and intraoperative ultrasonography, we delineated the exact size of hepatic parenchyma for dissection in HCC.

## TECHNIQUE CTHA

Using a helical CT unit, CTHA was performed before surgery by administering the contrast medium via the right or left hepatic artery or both [12]. Data acquisition commenced 5–8 and 45–50 sec after the initiation of a transcatheter injection of 20–33 ml of 150–160 mg I/ml of the contrast medium. The injection rate was 1 ml/sec. Helical CT scanning was performed with a section thickness of 7–10 mm and a table feed speed of 7–10 mm/sec; 23–25 images were reconstructed in 7–10-mm increments. The direction of scanning was cephalo-caudal and the duration of scanning was 23–25 sec (mean: 23.7 sec).

## Determination of Resection Line

Basically, CT scans were taken at the early (arterial) and late (venous) phases of hepatic arteriography. The early phase of CTHA demonstrates the arterial blood supply of the tumor, whereas the late phase shows the drainage area, i.e., the adjacent liver stained after contrast material had washed out of the tumor (Fig. 1a,b). To determine the dissection line, the distance between the tumor edge and the peripheral margin of the drainage area was measured on CTHA images before surgery (Fig. 1b, arrow). After laparotomy, ultrasonography was performed to identify the tumor and draw the dissection line on the liver surface, including the surgical margin, i.e., the distance between the tumor and peripheral edge of the drainage area (Fig. 1c). Other intrahepatic structures such as the portal or hepatic vein are used as landmarks during this procedure. If necessary, ultrasonography is repeated after hepatic resection to confirm the adequacy of the surgical margin.

## RESULTS/COMMENTS

The optimal extent of hepatectomy for HCC (e.g., limited or extended hepatic resection) has been discussed based on postoperative prognosis like tumor recurrence or survival [3–8]. However, recent studies indicate that postoperative tumor recurrence results not only from remaining undetectable metastatic foci but from metachronous, multicentric hepatocarcinogenesis. The incidence of tumor recurrence due to multicentric hepatocarcinogenesis is approximately 50% in hepatectomized patients with HCC[13,14]. Therefore, the extent of the surgical

\*Correspondence to: Masato Sakon, MD, The Second Department of Surgery, Osaka University Medical School, 2-2, Yamadaoka, Suita, Osaka, Japan 565-0871. Fax: (+81) 6-6879-3259.  
E-mail: msakon@surg2.med.osaka-u.ac.jp

Accepted 30 December 1999

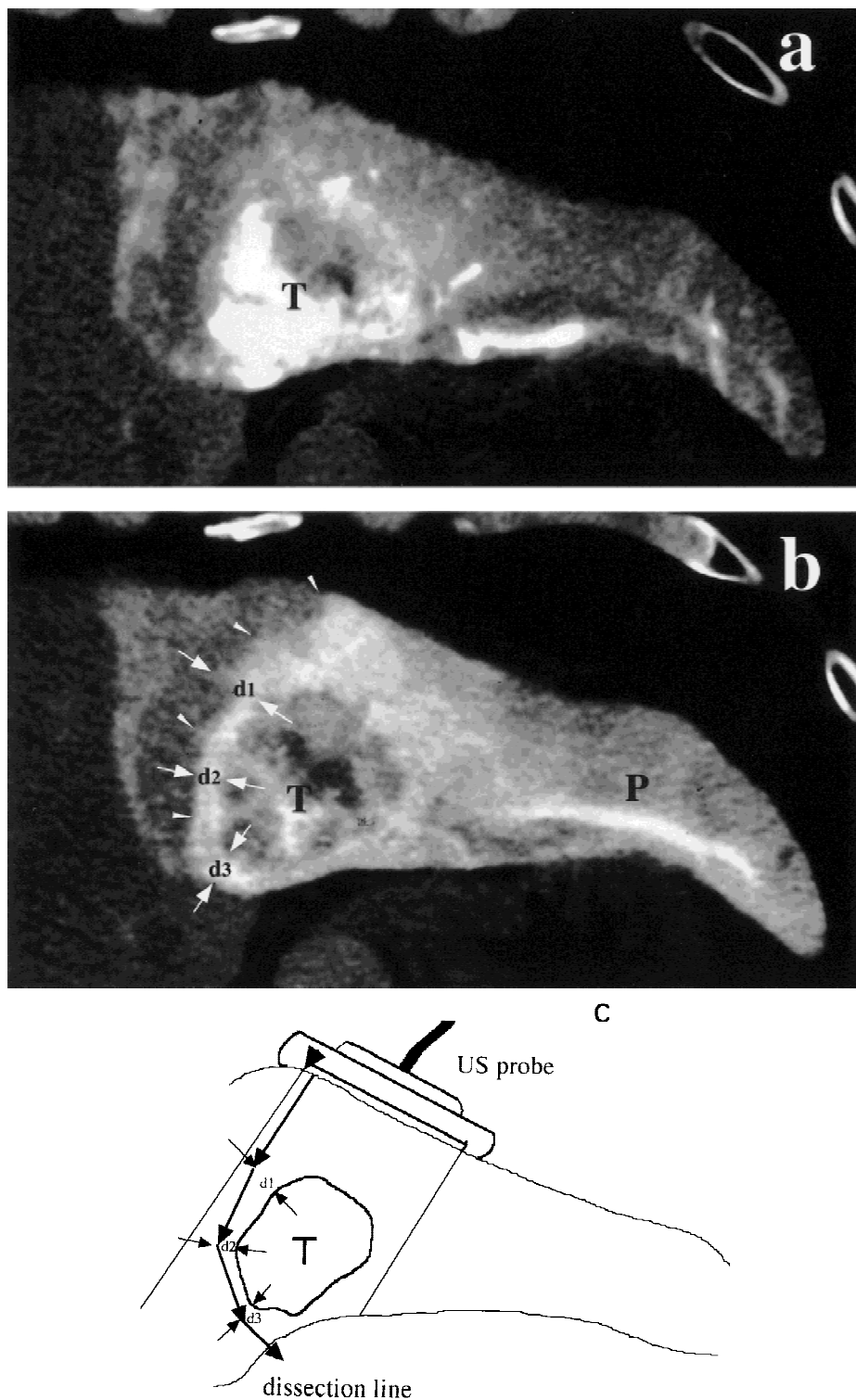


Fig. 1. Determination of hepatic resection line using CTHA and ultrasonography. **a:** Early-phase CTHA. Angiography was performed by injecting the contrast medium into the left hepatic artery. T, tumor. **b:** Late-phase CTHA. Arrowheads, borderline of tumor blood drainage area; P, portal vein; d1, d2, d3: the distance between tumor and the blood drainage area of the tumor, i.e., the width of the sufficient surgical margin. **c:** Intraoperative ultrasonography. The dissection line was determined by ultrasonography, taking the width of the surgical margin (d1, d2, d3) and easiness of hepatectomy into account.

margin for hepatic resection of HCC now becomes vague although hepatectomy remains the mainstay of treatment for HCC [15]. Using CTHA and intraoperative ultrasonography, it is possible to determine precisely the hepatic parenchyma in which blood drains from the tumor area, representing the high-risk liver tissue for micrometastases (Fig. 1). In addition, CTHA reveals the drainage blood vessels of the tumor, the portal venule, the feeding area of which should also be resected for a complete cure. Hepatectomy with this technique was performed in 22 patients with HCC. Nonanatomical, limited resection rather than major resection was indicated in most patients (20 of 22 cases) when the extent of hepatectomy was determined according to the tumor blood drainage area. Although this technique clearly demonstrates the reasonable extent of hepatectomy for HCC, its clinical significance has to be elucidated by future study.

In conclusion, the extent of hepatectomy should be determined prospectively based on the hemodynamics of the tumor. The latter can be precisely determined by CTHA and resected using intraoperative ultrasonography.

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